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# Overcoming problems in Turkey's renewable energy policy: How can EU contribute?☆

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ABSTRACT

Fossil fuels cover most of the energy demand in the world, and this creates significant social, economic and environmental problems. Many countries have taken measures to increase the share of renewable energy sources (RES), especially in electricity generation, and the review of literature shows that the success of a country in RES diffusion depends on a comprehensive renewable energy policy which combines political commitment with stable and long-term support measures that stimulate technological innovation. As the largest economy in the world, EU has also taken steps to increase RES usage in electricity generation in member states. Similar to other developing countries, Turkey is learning lessons from EU experiences regarding RES policies, and Turkey is also reforming its legal framework in line with *acquis communautaire* as a candidate country. As a result, EU has a multiway impact on Turkey's renewable energy policy. An overview of Turkey's renewable energy policy showed that EU has significantly contributed to Turkey in shaping its renewable energy policy, and Turkey should increase cooperation with EU in order to utilize its renewable energy potential.


**Contents**



## 1. Introduction

Increasing energy demand and problems caused by intensive use of fossil fuels force countries to use cleaner and more reliable energy sources. As a part of search for alternative sources, many countries have taken measures to increase the share of renewable energy sources (RES) in electricity generation. While some countries have successfully increased share of RES in electricity generation, some have failed despite their renewable energy potential. The review of literature shows that the success in the exploitation of RES potential depends on a comprehensive renewable energy policy which combines political commitment with stable and long-term support measures that stimulate technological innovations.

As the largest economy in the world, European Union (EU) consumes a significant amount of energy, and it is encountering problems related with high dependency on fossil fuels. Therefore, it has taken steps to eliminate these problems via a number of measures including RES usage in electricity generation. Similar to

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other developing countries, Turkey is learning lessons from EU experiences regarding RES policies, and Turkey is also reforming its legal framework in line with *acquis communautaire* as a candidate country for EU membership. As a result, EU has a multiway impact on Turkey's renewable energy policy.

Although Turkey's renewable energy policy has been widely discussed in literature so far by various authors such as Bilgen et al. [1], Yılmaz [2], and Ozgur [3], the role and contributions of EU in shaping Turkey's renewable energy policy have not been examined thoroughly. Therefore, this article aims to discuss the problems in Turkey's renewable energy policy, and tries to answer how EU can contribute in solving these problems. Section 2 presents literature review regarding the components of a successful renewable energy policy derived mostly from European experiences. Section 3 summarizes EU's renewable energy policy and how it interacts with member states' and candidate countries' renewable energy policies. Sections 4 and 5 evaluate the flaws in Turkey's renewable energy policy, and discuss the role of EU in solving these problems. Section 6 concludes the article.

## 2. Developing a successful renewable energy policy

Since the first Industrial Revolution, fossil fuels have dominated world energy system. However, increased fossil fuel consumption has caused economic, social and environmental problems, and these problems have forced policy makers to search for alternative sources [4]. As promising source, RES have attracted significant attention; however, some countries have failed to incorporate RES in their energy system while some countries have been successful in doing so. A review of literature and experiences of successful countries shows that diffusion of RES technologies requires a comprehensive policy that covers political, social and economical aspects of RES technologies, and renewable energy policy must be based on three fundamental elements: (1) political commitment, (2) market creation and (3) support for energy technology development [4–12].

### 2.1. Political commitment

The first component of a successful renewable energy policy is political commitment which refers to how strongly a government supports RES as an indispensible component of its energy policy. Political commitment is shaped by both domestic factors such as natural resource endowment, political power of advocacy groups or political parties in government, and by international factors notably obligations emerging from international agreements. How successfully these factors pave the way for a consistent, transparent and predictable support framework that includes removal of political, administrative and social barriers, and reduction of uncertainities affects the success of a country in promotion of RES [4,7,10,13,14].

Natural resource endowment and the availability of domestic resources to achieve a country's policy objectives (such as energy security, environmental protection etc.) is the first main domestic factor shaping political commitment. Countries with a higher energy import dependency, less available natural resources and less electricity generation options have been more successful in deployment of RES technologies. The success of Germany in RES diffusion is partly attributed to the lack of available fossil resources and exclusion of nuclear power option as a result of major public protests after Chernobyl accident [14,15]. On the contrary, UK's preference for gas powered plants and nuclear energy in electricity generation (which also helped UK to decrease its greenhouse gas emissions) and subsidization of coal industry prevented UK from using its significant renewable energy potential [14]. Similarly, the power of gas industry in Netherlands caused similar problems and hampered RES diffusion [16].

The approach of the ruling political party is the second main domestic factor in RES diffusion [15,17]. Most governments target similar goals in supporting RES such as supply security, reduction of emissions etc. However, the success of this policy enhances when a government gives increasing emphasis on RES not only for electricity generation but also for providing other goals such as increasing employment, providing rural development and enhancing export capacity. In this respect, the government's perception of the role of energy markets in environmental and energy policies determines the success of a renewable energy policy. Liberalized electricity markets increase competition, thus eliminate inefficiencies and offer high quality services to consumers, and firms generally prefer technologies which become profitable in short-term [18]. In addition, rising risks and uncertainties in these markets generally have adverse effects on the investments in new technologies notably RES technologies. The experiences of successful countries shows that establishment of a competitive market system that incorporate social responsibilities into support schemes (carbon tax etc.) while decreasing risks and providing market for new technologies for a certain period lie at the center of a successful renewable energy policy, rather than exclusion of such mechanisms and leaving investment decisions to "technology-neutral" markets [10,15]. The success of German and Danish renewable energy policies in stimulating RES investments are attributed to the governments' long-term support that combine energy policy and environmental policy goals and aim to achieve a set of targets from securing electricity supply to job creation [17]. On the other hand, the failure of UK is partly attributed to UK's strong emphasis for electricity market liberalization in the early 1990s for achieving efficiency and effectiveness, and the establishment of "Non-Fossil Fuel Obligation-NFFO" system in UK which failed to decrease risks and to provide market for RES proved to be an unsuccessful model for RES diffusion [10,16].

The role of advocacy coalitions in policy-making is the third main domestic factor that shapes political commitment. Experience shows that countries with stronger advocacy coalitions that support renewable energy have been able to establish more favorable and stable support systems [14,17]. In this respect, the level of public awareness (environmental consciousness) affects the strength of advocacy coalitions and policy choices of governments. It is no wonder that successful countries such as Denmark and Germany also have a high-level of public awareness compared to other countries [17].

Inclusion of local authorities in decision-making and planning processes is the fourth main domestic factor that affects political commitment. The success of Germany and Denmark is partly attributed to the role of local authorities in RES investments, while UK was criticized for centralized planning system and low representation of advocacy coalitions in decision processes [16,17]. Moreover, the administrative procedures in Germany and Denmark allow small and medium-sized enterprises (SMEs), cooperatives and small investors (individuals or farmers) to build RES plants and sell electricity to the system, and this contributes to local residents' support for RES investments [14,15,17,19]. On the other hand, UK's centralized decision-making process and large companies' role in RES projects increased local resistance for RES investments in UK [12,19].

Apart from domestic factors, international factors notably international obligations affect political commitment. These factors/obligations may result from an international agreement such as Kyoto Protocol or a supranational body (European Union). The stricter these obligations are, the more is their power to affect political commitment. RES technologies have gained importance internationally after the ratification of "United Nations Framework Convention on Climate Change—UNFCCC" in 1992, and the

ratification of Kyoto Protocol in 2005 has been a policy driver for reducing greenhouse gas (GHG) emissions and increasing the use of RES technologies. Apart from international organizations, European Union which is a supranational organization and has more sanction power than international agreements has significantly affected policy regime in some member states such as UK and Ireland, and the *acquis communautaire* has been the major policy driver in supporting RES diffusion in these countries [12].

### 2.2. Market creation

The second component of a successful renewable energy policy is market creation which refers to increasing the share of RES in electricity generation and bringing RES costs down to a competitive level [20]. Market creation includes removal of non-technical barriers and implementation of appropriate incentives which vary according to the technological maturity of RES, market competitiveness, and overall energy system's cost efficiency and reliability. Governments can use a variety of incentive mechanisms and measures to support RES diffusion, which either affect demand or supply [21]. These measures can be grouped under two main headings: (1) support mechanisms, and (2) removal of non-technical (administrative, social or market) barriers.

Support mechanisms are used to increase the share of RES generation by providing funds and other incentives for generators, customers, manufacturers etc. These systems can be grouped under three headings as primary support mechanisms, secondary (market-based) support mechanisms and adoption of fiscal and administrative measures.

The first type of support mechanism, primary support mechanism, introduces legal obligations on power utilities to buy electricity from renewable energy sources. There are three main primary support mechanisms; Feed-in Tariffs (FITs) or Feed-in Premiums (FIPs), Quota systems, Tendering systems. In FITs, government or regulatory authority determine the price of electricity that power utilities have to buy for a specified time. The first feed-in mechanisms were used in California during 1980s, whereas Portugal, Germany, Denmark and Spain were the first European countries that used FITs at the beginning of 1990s [7]. FIPs are similar to FITs, but, a guaranteed premium is paid to RES producers in addition to their income from electricity sale. Contrary to FITs, FIPs are considered a more effective way of internalizing external costs; however, they imply higher risks than FITs, and total revenue received by RES owner depends on market prices [22]. In quota systems, government or regulatory authority determine the minimum share of capacity to be supplied from RES and imposes a penalty on those who fail to meet this obligation. The advantage of this system is that it leads to promotion of the lowest cost RES technology, and it is more compatible with competitive electricity markets. On the other hand, it has more transaction costs, leads to more volatile prices, leads less innovation than FITs and cannot alleviate risks as FITs [7,20,23]. In tendering systems (or bidding schemes), government or regulatory authority determines the capacity to be supplied from a specific RES, and makes a tender for construction. Tendering systems were used in UK and Ireland, but they were abandoned due to major drawbacks like significant transaction costs, planning and permitting problems, unsustainable bids, uncompleted projects and high risks for investors [7].

The second type of support mechanism, secondary-support mechanisms aim to provide extra gains to RES technologies in electricity markets. Unlike the primary support mechanisms, these mechanisms do not set any mandatory targets on prices or installations, but set targets for the acquisition of certificates related with carbon emissions or RES generation. There are three types of these mechanisms: (1) Renewable Energy Certificates (REC) also referred as Renewable Portfolio Standards (RPS) or Tradable Green Certificates (TGC), (2) Emission Trading Certificates (ETC), and (3) Voluntary Market-Mechanisms. RECs are mostly used with quota systems, and government or regulatory authority determines the minimum quantity of RECs that consumer or utilities must have. Emission Trading Certificates (ETCs) also function like RECs/TGCs, but this model uses emission limits. Since RES technologies emit much less GHG than conventional power plants, the owners of RES can sell these certificates in the market and get extra funds. Unlike these two systems, Voluntary Market-Mechanism (VMM) involves no direct government intervention, and depends on consumers' choices. Overall, secondary measures contribute to the diffusion of RES technologies; however, experience shows that these types of measures are not sufficient enough, and primary support mechanisms are required [20,22].

Besides the primary and secondary mechanisms listed above, governments can provide a wide range of fiscal and administrative incentives like tax reliefs, tax credits, loan assistances, subsidies, grid connection priorities, research support etc. in order to encourage RES investments. Generally all these incentives are used to support instruments in the first and second group.

The choice of these mechanisms mainly depends on the social, economic and political context of the country. The main issue in market creation is the application of long-term, stable and consistent support mechanisms which are essential to increase RES investments and to reduce risks and associated costs. Although it is also argued that long term mechanisms reduce political flexibility, some measures such as contingency clauses and off-ramp triggers can be established in these mechanisms to alleviate the burdens of these mechanisms [24].

The second perspective of market creation is the removal of non-technical (market, administrative and social) barriers. There are a number of market barriers such as negative externalities of conventional energy sources, uncompetitive market prices, price distortions, information and transaction costs etc., and governments should take measures where market fails [25]. Governments may take a number of measures such as standardization, removal of subsidies or introduction of taxes (such as carbon tax) to eliminate market barriers. However, government's intervention in markets may also create problems and distort effective functioning of markets. Hence, appropriate and effective measures should be chosen in overcoming market failures. Administrative barriers are the second type of barrier which effects RES investments to a great extent. Complex investment authorization procedures and strict requirements create uncertainties and risks for investors, and these often delay new investments. The experiences of successful countries show that establishment of one-stop authorization agencies, defining objective, non-discriminatory and transparent guidelines and rules for authorization procedures, establishment of pre-planning mechanisms and increasing co-operation among authorization bodies foster renewable energy deployment. The third type of barrier, social barriers, mostly arises from the local impacts of RES investments. Governments have to take measures such as including local authorities into decision-making processes, informing residents about the impacts of RES investments and providing fiscal or other incentives for residents in order to alleviate social concerns.

### 2.3. Support for energy technology development

Technology development is the third aspect of a successful renewable energy policy, and it is essential to reduce technical barriers and to enhance commercial competitiveness of RES technologies [5,15]. There are five main stages of technology development, namely research, experimental development, demonstration, deployment and diffusion [26]. The first three stages of technology

development, research, experimental development and demonstration (RD&D) aim to increase knowledge stock, to devise new applications and to bring technologies closer to market by testing [27]. RD&D have some features of public-goods, and these features adversely affect private sector RD&D investments in competitive markets. In addition, electricity sector has some significant differences from other sectors such as high interdependence among actors and complex safety standards that eliminate flexibility, high-cost and capital-intensive investments etc. that increase resistance to new technologies and hinder diffusion of new technologies [18,28]. Moreover, restructuring of electricity markets and privatization of utilities in 1990s have coincided with decrease in government energy RD&D expenditures as a share of GDP in many countries, and concerns have increased regarding whether market restructuring would delay transformation to a more sustainable energy pattern. Therefore, government support for RD&D is crucial in energy technology development, and governments have to encourage energy RD&D expenditures by providing incentives for private investors or allocating more resources for government RD&D expenditures [29].

The fourth and fifth stages of technology development are deployment and diffusion. Deployment includes pre-commercial and niche deployment, and diffusion refers to widespread deployment of a new technology. Unlike RD&D, deployment and diffusion are related with demand measures, and the support mechanisms discussed in the previous section also support deployment and diffusion of new technologies. On the other hand, depending only on private investors is not enough to eliminate "valley of death" among stages of technology development, and government-supported deployment programs are required to foster technology development [25,29]. Experiences of successful countries show that investment in niche-markets, establishment of deployment programs or public procurement schemes, and inclusion of stakeholders to benefit from learning effects encourage deployment and diffusion of new technologies [25]. For example, Germany introduced the "100 MW Wind Programme" in 1989 which was later extended to "250 MW Wind Programme" in 1991 to foster deployment of wind technology, and introduced "100 000 Roofs Solar Power Programme" in 1999 to foster installation or extension of PV systems larger than 1 kW. A similar approach was pursued by Denmark by introducing SOL-300 Project in 1998, and SOL-1000 Project in 2001 [30].

Localization-domestic manufacturing is another aspect of technology development and plays an important role in technology development, in providing economic benefits (employment, cost savings, export possibilities) and increasing local support. In this respect, the approach pursued by government and by firms to localize technology (either create own technology, technology transfer or production by a foreign firm in country) affects the extent of these benefits. Governments can use a variety of measures such as local content requirements, financial and tax incentives, credit assistances and quality certification to increase demand and encourage manufacturers' investments [31]. Successful countries also aim to increase localization and gaining early-mover advantage by creating their own RES technologies.

## 3. European Union and renewable energy

European Union is the biggest economy in the world, and it is one of the biggest energy consumers and GHG emitters in the world [32]. As in other developed countries, all EU member states cover their energy demand mostly from fossil fuels. In 2008, the share of renewable energy in final energy consumption was 10.3% in EU-27, while it was as low as 2% or even lower in some member states such as UK or Malta, or it was more than 30% as in Sweden or Finland [33]. The share of RES in electricity generation was relatively higher, and approximately 16% of electricity generation was supplied from RES plants. Contrary to total energy consumption, the share of RES in electricity generation is higher than 50% in some member states such as Austria or Sweden [33].

Energy was at the center of early European integration process, and two of the three main constituting EU treaties are directly related with energy-1951 ECSC Treaty and 1957 EURATOM Treaty. On the other hand, a common EU energy policy has not been established due to the different policy priorities of member states and the sensitivity of the energy issues. The oil-shocks and growing environmental concerns led member states to establish a common approach in energy policies in the mid-70s. On the other hand, cooperation was limited to RD&D and innovation, and energy was mostly discussed under single market or environmental issues. In the mid-90s, common energy policy discussions were intensified as sustainable development and environmental protection were becoming a central issue of EU's all policy areas. Since the ratification of Maastricht Treaty, establishment of an internal energy market became a keystone in EU's energy policy formulation to provide energy supply security, to reduce GHG emissions and to introduce low-carbon and efficient technologies. In addition, the needs and problems of member states, and the growing role of EU in international politics as a supporter of sustainable development and environmental protection forced EU to follow a common and pro-active approach not only in establishing internal energy market, but also in other energy areas such as renewable energy and energy security. As a result, EU has directed its attention to increase use of RES, to reduce energy demand and to limit the adverse effects of energy use on environment [23]. Adoption of European Climate Change Policy (ECCP) in 2001 marked the beginning of a comprehensive strategy in energy issues [6], and these efforts were strengthened in 2007 when the Council determined three main objectives that form the basis of an integrated energy policy of EU: (1) energy security, (2) economic growth and (3) environmental sustainability [34]. Increasing the share of renewable energy sources to 20% in overall EU energy consumption by 2020 is one of the six determined targets to achieve these objectives [34]. In the following years, EU has adopted new directives in line with these objectives, and increased cooperation with third countries to achieve transformation to sustainable energy production and consumption patterns. Nevertheless, member states' insistence on their competence over domestic energy resources and policy choices has not allowed formulation of a comprehensive common energy policy so far, and it is not expected in the near future [6].

EU's renewable energy policy backs to the early 1970s when oil shocks hit European countries. As a response, renewable energy research activities were intensified and some resources were allocated to non-fossil fuel generation technologies and energy efficiency measures. In the mid-80s, European Commission initiated ALTENER program which aimed to increase cooperation in renewable energy research. However, a union-wide approach to RES begun in the mid-90s when national and international environmental concerns aroused, energy security problems emerged and economic integration and establishment of internal market entered a new phase. A comprehensive renewable energy strategy was firstly discussed in the Green Paper in 1996 [35] and the White Paper in 1997 [36]. In these papers, renewable energy was accepted both as a main element of EU's general energy strategy and as a significant contributor to other policy objectives. Moreover, the White Paper aimed increasing the share of renewable energy to 12% of total energy consumption by 2010 [36]. Commission stressed the importance of three main mechanisms to increase the deployment of RES technologies in the White Paper. The first proposed main mechanism was the

establishment of internal energy market. The Commission underlined the importance of internal energy market to internalize costs of externalities of energy sources, to provide transparency and to increase effectiveness in investments. The second proposed mechanism was the establishment of an EU-wide strategy accompanied with legally binding measures to remove political, administrative, economic and social barriers to deployment and trade of renewable technologies. The third proposed mechanism was increasing RD&D and innovation investments by strengthening co-operation among member states and allocation of funds for research activities [35,36]. The importance of renewable energy technologies was also iterated in the Green Paper on the security of energy supply in 2000, and internalization of social costs, strengthening infrastructure and interconnections between transmission networks and support for technology development were proposed for the diffusion of RES technologies [37,38].

In 2001, Commission initiated European Climate Change Action program which set the action to decrease GHG emissions. In the same year, a significant step was taken with the adoption of Directive 2001/77/EC which aims to increase the share of renewable energy sources in electricity production and to create a basis for a future Community framework [39]. The directive set national indicative renewable energy targets which were determined by technical and economic potentials of member states, and member states had to take necessary measures to encourage RES share in total electricity consumption. It was acknowledged in the directive that primary support mechanisms were important in penetration of renewable energy technologies; however, it was also stated that it was too early to define an EU-wide primary support scheme because of the lack of experience regarding the success of different support schemes. Therefore, the directive permitted use of national support systems for a transitional period of at least seven years until a new EU-wide regulatory framework would be adopted. In addition, the directive defined the scope of renewable energy technologies, and put an end to different definitions of renewable energies in member states [14]. Moreover, the directive established "Renewable Energy Guarantees of Origin—GO" system in which member states had to provide RES generators at national level, and had to mutually recognize the other guarantees of origin systems. GO serves as a guarantee for the generation of a specified quantity of electricity from renewable sources, and it aims in increasing transparency and providing a common platform to facilitate renewable electricity trade between Member States.

The directive established a major legal framework for the promotion of renewable energy technologies by reducing administrative barriers and grid-accession problems. On the other hand, it did not include provisions to force member states to increase RES diffusion, and it did not set any penalties if any country fails to achieve its target. The biggest flaw of the directive was the weakness of enforcement regime for RES targets, and it was the most significant reason for the repeal of this directive and enactment of new Directive 2009/28/EC.

In addition to establishing legal framework, EU intensified its efforts in renewable energy policies in technological innovation. In 2003, Intelligent Energy-Europe Programme (IEEP) which aimed to reduce non-technical barriers by supporting projects to foster capacity building, spreading of know-how, skills and methods, increasing education and training, and increasing public awareness was initiated. Moreover, EU established energy technology platforms (ETPs) during 2005–2007 which aim to increase research and development in renewable energy technologies by bringing interested parties together. Furthermore, Strategic Energy Technology Plan (SETP) was adopted in 2007 to accelerate technological innovations by reinforcing research, increasing supports to stimulate diffusion of new technologies and removing non-technological barriers. SETP foresees joint planning, allocation of more resources, effective implementation of support measures, establishing industrial initiatives and reinforcing international cooperation in renewable technologies.

Besides, EU also intensified its efforts to establish a comprehensive renewable energy policy. In its assessment report of 2005, European Commission stressed the importance of harmonization of support systems for a better functioning of internal electricity market, and it proposed *co-operation* among member states and *optimization of national systems* by reducing administrative and grid access barriers, encouraging technological diversity and providing compatibility with internal market [40]. In 2007, "Renewable Energy Road Map" which showed a change in EU's approach from indicative targets to long-term binding targets was published. The roadmap stressed the importance of removal of non-technical barriers, consideration of social and environmental concerns, and internal energy market for effectiveness, efficiency and transparency in energy investments [41]. The emphasis of Commission for binding targets was also supported by the Council in March 2007.

These developments in political realm resulted in the enactment of Directive 2009/28/EC [42] in 2009.[2] The most significant feature of the Directive is the setting of binding renewable energy targets (both in electricity and transport sector) for 2020. The Directive does not establish an EU-wide primary support scheme, and allows member states to use their national support schemes. Moreover, it lays down rules for reducing administrative barriers and increasing transparency in authorization procedures, strengthening cooperation among member states, improving grid-access procedures for RES. It also enhances the Commission's role in monitoring member states compliance with the provisions of the Directive.

In addition to steps taken in legal framework, EU provided significant amounts of funds to renewable energy projects and technological innovation via European Commission funds or European Investment Bank and EBRD. European Commission uses four types of programs to fund renewable energy projects. The first one is The Multi-annual Framework Programme (FP) for Research and Technology Development (currently 7th FP is under progress) that is aimed for research policy. The second program is the Competitiveness and Innovation Framework Programme (CP) that allocates funds to renewable energy projects via Entrepreneurship and Innovation Programme and Intelligent Energy Europe Programme. The third mechanism is the European Funds (Structural Funds and Cohesion Fund) that aim to reduce the gaps between EU's most developed and less developed regions and to foster cohesion among member states. The fourth mechanism is the European Energy Programme for Recovery which was initiated in 2009 to alleviate the burdens of energy crises such as the one in 2008, and provides financial assistance to infrastructure, carbon storage and renewable energy investments [43]. EU has allocated more than seven billion Euros for renewable energy projects in these programs, and furthermore EIB and ERBD provide low-interest loans, equity investments and investment funds for renewable energy projects.

Besides specific measures taken for renewable energy diffusion, EU's environmental policy also includes renewable energy as an important resource to protect environment and to achieve EU's emission targets, and EU has adopted some environmental policy measures that also help diffusion of renewable energy technologies. A primary example is the initialization of European Emission Trading Scheme (EU ETS) in 2003 when the European Council

[2] In 2003, EU adopted Directive on Biofuels for Transport (2003/30/EC) on production of biofules. It was repealed with this directive.

formally adopted the so-called Emissions Trading Directive to internalize external costs of emissions and direct investors to low-carbon emission technologies [44,45]. As a non-carbon source, RES benefit from EU ETS in two ways: Firstly, EU ETS internalizes costs of carbon emissions by pricing emissions, and increases the competitiveness of renewable energy technologies by reducing the relative price of RES technologies against carbon-emitting technologies. Secondly, it stimulates support and investments for low-emission technologies notably for renewable technologies. The second environmental measure is the adoption of environmental tax for energy products in 2003 [46]. Although the taxes are lower than proposed by European Parliament, it is an important step in applying EU's "polluter-pays principle" and it also helps diffusion of RES technologies [22]. The third measure is the application of state aid to environmental-friendly technologies and prohibition of some state aids to conventional technologies. Generally, significant amounts of aids or subsidies are provided to conventional resources in order to protect traditional sectors or to secure energy supply. However, these aids create economic and environmental burdens, and decrease competitiveness of RES technologies. European Union has adopted guidelines in a number of policy areas that define the type and the scope of state aids applicable. Renewable energy technologies are also included in these guidelines, and states can provide aids for the renewable energy diffusion or technology development.

In addition to measures mentioned above, strengthening the power of advocacy coalitions is another positive impact of EU on renewable energy technologies. EU institutions have been supporter of various industrial or environmental organizations, and cooperate with these organizations in renewable energy projects and allocate funds to these organizations. Moreover, these organizations have been able to participate in decision-making process in EU's institutions notably in European Parliament.

Overall, an overview of EU's renewable energy policy shows that EU has been an important factor in fulfilling three requirements of a sound renewable energy policy. Although EU has not achieved to form a common primary support scheme for renewable energies, it has managed to lay down general principles and to set binding targets for utilizing renewable energy potential [47]. Moreover, EU has forced member states to reduce non-technical barriers and to establish transparent, objective and non-discriminatory rules for RES investments. Additionally, it has established an important secondary-support mechanism for renewable technologies via EU ETS scheme. Finally, EU's approach to technological development in RES technologies as a mean to increase employment and social cohesion in the EU and to enhance EU's export capacity helped allocation of significant amount of funds to technology development. On the other hand, EU's strong emphasis on internal energy market has adverse affects on RES diffusion in some member states, and this creates some problems in political commitment. Following the adoption of first electricity market directive, some member states changed their support schemes with more market-oriented ones (such as Denmark), and it is claimed that this change adversely affected RES penetration in these countries [15]. Nevertheless, the legal framework and mechanisms established by EU has positive impact on the three components of a successful renewable energy policy.

## 4. An overview of Turkey's renewable energy policy

Turkey has been experiencing a high economic growth in recent years, and currently it is the 17th biggest economy in the world. High economic growth accompanied with increasing population and urbanization have increased energy demand, and Turkey's total primary energy consumption (TPEC) has increased more than 4% annually since 2000, the highest rate among OECD countries. The increasing energy demand has been covered mostly by fossil fuels, and fossil fuels met nearly 92% of the total energy consumption in 2009 (natural gas—32%, oil—29.9%, coal—29.5%), while the rest is provided from renewable energies notably hydraulic energy. In addition, increasing fossil fuel use worsened energy import dependency, and Turkey had to import more than 70% of its primary energy demand, 98% of its natural gas consumption and 93% of oil consumption in 2009 [48].

The high import dependency and high energy demand increase have been on Turkey's energy agenda in the last decades, and Turkey tried to shape its energy policy to secure energy supply and to cover increasing demand. However, a comprehensive and long-term energy strategy to use domestic resources and to increase energy efficiency could not be achieved in the 1980s and 1990s. Moreover, high electricity demand growth rate and budgetary constraints for energy investment projects resulted in the adoptation of Built-Operate-Transfer and Built-Operate-Own schemes in electricity generation which resulted in a steep increase in natural gas usage and exaggerated security concerns. Currently, 49% of electricity generation is covered by natural gas plants, while 20% is covered by coal and 18% is covered by hydropower plants. In order to eliminate problems related with high dependency on imported fuels, recent Turkish governments have been trying to establish an energy strategy based on securing energy supply, reducing import dependency, increasing energy efficiency, minimizing environmental degradation and establishment of liberalized and competitive electricity and natural gas markets. As a part of this strategy, governments have focused on diversification of energy sources including construction of nuclear power plants and increasing the share of renewable energy sources [49].

Turkey has a significant renewable energy potential for electricity generation and heating. According to IEA, Turkey's total realizable renewable energy potential is equal to 13% of EU-27's total potential, and Turkey ranks fifth after Germany, France, Spain and UK [50]. According to Turkey's Ministry of Energy and Natural Resources (MENR) data, Turkey has a total of 229,900 GWh/yr electricity generation potential from renewable energy sources mostly from hydropower and wind as shown in Table 1; however, Turkey has not utilized even half of its potential. In hydropower, it is estimated that Turkey's economic potential is 36,000 MW (with an annual average generation potential of 144,000 GWh/yr), and only 16,934 MW has been installed at the end of 2010. The government aims to exploit this potential fully in 2023. In wind power, economic potential is estimated to be 48,000 MW (with an annual average generation potential of 60,000 GWh/yr), but only 1587 MW capacity has been installed. The government aims to increase installed capacity to 10,000 MW in 2014, and 20,000 MW in 2023. In solar power, it is estimated that Turkey's economic potential is 50,000 MW (with an annual average generation potential of 7500 GWh/yr); however,

**Table 1**
Renewable energy potential and installed capacity in Turkey.
*Source*: MENR [54].

| Source | Economic potential (MW) | Installed capacity (MW—in 2010) | 2023 Target (MW) | Annual average generation potential (GWh/yr) |
|---|---|---|---|---|
| Hydropower | 36,000 | 16,934 | 36,000 | 144,000 |
| Wind | 48,000 | 1587 | 20,000 | 60,000 |
| Solar | 50,000 | – | 3000 | 7500 |
| Geothermal | 600 | 94 | 600 | 4400 |
| Biomass | 2000 | 44 | 2000 | 14,000 |
| Total | 136,600 | 18,659 | 61,600 | 229,900 |

no solar power plant has been installed yet, and there have been small-scale applications such as traffic lightning, lighthouses etc. Turkey will initiate a tendering mechanism in 2013 for the installment of PV power plants, and currently secondary legislation for this tendering mechanism is being prepared. In geothermal energy, Turkey is one of the countries with high potential in the world, and in some regions it is used for heating purposes [51,52]. Nonetheless, the share of geothermal energy in electricity generation is relatively low, and only 668 GWh electricity was generated from geothermal energy in 2010 [53].

Despite its significant renewable energy potential, Turkey has not exploited it adequately, large hydropower energy projects were given priority and few promotional measures were provided to small renewable projects and no financial support was provided to RES technologies until the early 2000s [55]. The first support mechanism was provided by Electricity Market Licensing Regulation (a by-Law) which was adopted in 2002. However, this mechanism was only focusing on administrative and grid connection problems, and it did not include any financial incentives for renewable energy projects. In 2005, Law no. 5346 "Law on the Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy" (hereafter RES Law) that aims to expand utilization of renewable energy resources via a number of mechanisms was enacted [56]. The first mechanism RES Law envisages is the adoption of FIT for RES support. The law provided a one feed-in tariff (starting from 2007) for all types of RES plants to be commissioned before 2011 and have been in operation less than 10 years. The tariff was determined as the average wholesale price of the previous year, but it could not be less than 5 euro cents/kWh and could not exceed 5.5 euro cents/kWh. The second mechanism is the certification of Renewable Energy Resource (similar to GO in EU Directive), and purchase obligations for retail sale companies. Retail sale companies have to sell electricity from RES in proportion with their share in domestic market and their electricity sale in the previous year. The third mechanism is the grid-accession priorities and conveniences for project preparation and land acquisition that aim to reduce administrative process for RES investments.

With the enactment of RES Law, renewable energy license applications, notably in hydropower and wind, increased considerably; on the other hand, some problems emerged and adversely affected RES investments. While license applications increased, it appeared that some of these applications were made to gain first-mover advantage, and only aimed to sell the license to other companies at high prices. This problem was complicated with the uncompleted investments, and new measures were taken to prevent such applications. However, the measures have increased administrative hurdles and extended the time required to obtain licenses. Another problem emerged in the form of increasing wholesale prices. The increasing electricity demand resulted in an increase of wholesale prices and even exceeded the maximum-level tariff envisaged in RES Law [57]. The third problem emerged with the growing local opposition against RES investments notably small hydroelectric plants, and these disputes were taken to courts. In result, some projects have to be stopped or even canceled due to court decisions.

In order to overcome these problems and increase RES investments, Turkey made major changes in RES-Law in 2010 [58]. The first major change is the establishment of "Renewable Energy Support Mechanism—RESM". RESM will be applied to power plants commissioned between 2005 and 2015, and enables these plants to benefit from feed-in tariff for ten years. Moreover, unlike the unique tariff system established in the previous system, tariffs are determined according to the source type. In the RESM, hydro and wind plants will get 7.3 US cents/kWh, geothermal plants will get 10.5 US cents/kWh and biomass and solar plants will get 13.3 US cents/kWh. The second major change is the introduction of incentives for use of domestically manufactured mechanical/electro-mechanical equipments in RES plants. If a RES license owner uses domestically manufactured equipments, then an additional bonus, varying from 0.6 US cents/kWh–2.4 US cents/kWh according to source type and components, is added to its tariff. For example, bonus payments for wind power plants are USD 0.008 for blades, USD 0.010 for generator and power electronics. In hydropower plants, USD 0.013 is paid for turbines, and USD 0.010 is paid for generator and power electronics. This support is applicable to plants commissioned before 2015, and can be applied for five years. In addition to these changes, the coverage of renewable energy definition is extended with the inclusion of landfill gas, and more measures are taken to reduce administrative barriers and decrease grid accession problems.

## 5. Flaws in Turkey's renewable energy policy and the contributions of European Union

An overview of Turkey's renewable energy policy shows that even though Turkey has a significant renewable energy potential, it did not use it sufficiently, and it has been very slow in establishing an adequate RES support mechanism. When examined in detail, it becomes clear that a number of problems caused Turkey's failure in exploiting its renewable energy potential.

First of all, Turkey failed to formulate a comprehensive renewable energy policy and strategy. Prior to 2000s, governments favored large hydropower plants, and renewable energy was mostly considered in energy security context. Lack of available options for clean, secure and affordable electricity generation in Turkey could have created a favorable climate for RES investments at that time. However, the urgency to cover increasing energy demand and lack of funds led governments to take measures that favor reliable technologies with short construction time, low risks and low capital costs. Therefore, private investors preferred gas powered plants mostly, and Turkey's electricity system has become dependent on imported natural gas. In addition, electricity market restructuring in Turkey resulted in a preference of natural gas plants over RES plants. According to regulatory authority's data, installed capacity additions were 4579 MW for natural gas plants, 2312 MW for hydropower, and only 773 MW for wind energy between 2002 and 2009 [59].

Secondly, Turkey failed to benefit from other countries' experiences and encountered similar problems such as insufficient support, administrative obstacles and local opposition to RES investments. Some official documents such as Economic Development Plans or Electricity Strategy Paper of 2009 emphasize the importance of RES in securing energy supply, protecting the environment, helping rural development, and a 30% target is set for electricity generation from RES [60]. However, Turkey failed to form a strategy incorporating renewable energy targets and other policy objectives [52]. Moreover, Turkey has been very late in establishing its support mechanism; the RES Law was enacted in 2005, fifteen years later than Germany, twelve years later than Denmark, eight years later than Spain, and four years later than the first EU directive. Moreover, despite the fact that a FIT system was established, the law has to be revised because of insufficient support and failure to increase RES investments. In addition, although multiple tariffs are envisaged by the recent changes in the law, payments are still low compared to other EU countries as seen in Table 2.

Thirdly, RES investors encounter major administrative barriers related with the authorization, licensing and the construction of the projects. Licensing procedures are long and complex, and many government agencies are involved in permissions and approvals for investments. As a result, licensing may take several

**Table 2**
RES support payments (Euros/MW h) in some EU countries [61].

| Member state | Windpower 'On-shore' | Solar PV | Biomass | Hydro |
|---|---|---|---|---|
| Austria | 73 | 290–460 | 60–160 | n/a |
| Denmark | 35 | n/a | 39 | n/a |
| Germany | 50–90 | 290–550 | 80–120 | 40–130 |
| Greece | 70–90 | 550 | 70–80 | 70–80 |
| Italy | 300 | 360–440 | 200–300 | 220 |
| | Netherlands | 118 | 459–583 | 115–177 |
| 73–125 | | | | |
| Portugal | 74 | 310–450 | 100–110 | 75 |
| Spain | 73 | 320–340 | 107–158 | 77 |
| UK | 310 | 420 | 120 | 230 |
| Turkey[a,b] | 54 | 100 | 100 | 54 |

[a] The minimum payment.
[b] Calculated by the authors.

years, and become a significant obstacle in RES investments. Moreover, Turkey's regulations do not permit cooperatives and individuals to obtain generation license, and only limited-liability companies or joint-stock companies are given permission to obtain generation license. Therefore, local residents have to establish one of these companies in order to make RES investment; however, establishing a company is a long and costly process, and they have to deal with legal and financial liabilities.[3] As a result, local residents are refraining from RES investments, and non-local companies are making new investments which in turn increase local opposition. With the changes in 2010, small investors and cooperatives are given permission to construct, own and sell electricity generated from RES power plants to distribution companies, and these can benefit from support scheme without having generation license. However, unlicensed capacity cannot exceed 500 kW (which is low considering the recent technology improvements), and secondary legislation has just completed. Other major problems are the growing local opposition to RES projects and the low representation of local authorities and advocacy coalitions in decision making processes. Although public-opinion polls show that most citizens favor RES investments, local opposition has increased in recent years due to RES investments in critical sites that have historical, natural or touristic importance. Even worse, government insisted on constructions instead of finding ways to settle the problems, and most small-hydro projects were taken to courts, and most of the authorizations given for these projects were canceled by courts.

Technology development and localization of RES technologies are other problematic issues in Turkey's renewable energy policy. Although Turkey's technological policy-making dates back to 1960s, Turkey could not integrate its technology policy with economic policy and lagged behind other developing countries. In 2001, Government introduced "Vision 2023" project that aims to improve Turkey's technology and innovation profile and increase RD&D expenditures. However, problems related with costs, financing, creation and commercialization of knowledge, and other problems such as strict labor and fiscal regulations, weak protection of intellectual property rights and high share of informal economy still adversely affect Turkey's innovation and technology profile, and more efforts are needed to overcome these problems [63]. Similar problems are witnessed in Turkey's energy sector and affected energy RD&D expenditures. Turkey's total government energy RD&D expenditures were 8 million USD in 2007 which was 2.5% of Germany's and 0.209% of USA's government energy RD&D expenditures [64]. Moreover, Turkish government allocated more than 50% of its energy RD&D expenditures to fossil fuel technologies until late 1990s. Since then, growing support for renewable energy technologies and establishment of International Center for Hydrogen Energy Technologies (ICHET) in 2004 resulted in a major increase in the share of renewable and hydrogen technologies in government energy RD&D expenditures (from 25% in 2000 to more than 50% in 2007) [64]. Besides government expenditures, private sector energy (electricity, gas and water supply) RD&D expenditures are very low compared to developed countries, and their share was only 0.35% of total private RD&D expenditures in 2007 [65]. In addition to low RD&D expenditures, Turkey has a limited technology development and localization capacity in renewable energy technologies [52]. Even in hydropower plants that Turkey has been using for decades, a full localization has not been achieved, and some mechanical/electromechanical equipments used in hydropower plants are still being imported. In other technology types, significant share of equipments are being imported, and the contribution of domestic companies in component manufacturing is low. Local manufacturers mostly produce licensed equipments of foreign companies and engage in development of licensed designs, and only a few engineering companies engage in own technology development. In addition, some foreign companies have established manufacturing bases in Turkey, but these companies only manufacture RES equipments that are designed abroad, and many of these companies do not make RD&D investments in Turkey. Furthermore, Turkish governments have not initiated any deployment and diffusion programs as done in Germany or Denmark, and this also adversely affected technology development of RES diffusion [30].

Considering these problems and obstacles in Turkey's renewable energy policy, increasing cooperation with EU can help Turkey to correct these flaws and to increase utilization of its renewable energy potential. First of all, the significant contribution of EU to Turkey's renewable energy policy has been in political commitment. Most of the economic, political and social reforms in Turkey in recent years are mostly made because of EU accession negotiations with an aim to align Turkish legal framework in line with *acquis communautaire*, and the same is true for energy legislation notably regarding liberalization, energy efficiency and renewable energy. Turkey prioritized adoption of a program to increase the share of RES in electricity generation only after the introduction of "National Programme for the Adoption of the Acquis-NPAA" in 2001 [66]. Moreover, a renewable energy law proposal was taken into the agenda after the Council's "Accession Partnership" decision of 19 May 2003 that defined increasing the share of energy produced from renewable sources in Turkey as a short-term priority [67]. When the draft RES law was submitted to Grand Assembly in 2005, the Government stressed the role of EU as a major contributor for the enactment of the law. In 2005 Progress Report, enactment of RES Law was welcomed by the Commission, however, the lack of RES target was criticized, and the importance of an "ambitious target" for utilizing RES potential was stressed [68]. The Commission also emphasized creation of a stronger regulatory environment for fostering renewable energy use in its 2010 Progress Report [69].

Besides EU, the Kyoto Protocol was also stressed by official documents as an important factor for supporting RES technologies. However, Turkey ratified it in 2009, and Turkey's responsibilities will begin after 2012. Therefore, it has not been strong a driver in utilizing renewable energy as EU so far, and the weak enforcement power of Kyoto leaves EU as the strongest international factor shaping Turkey's renewable energy policy in the coming years. Another aspect of EU's role in political commitment is the formation of advocacy coalitions and providing public support to RES

[3] According to World Bank's Ease of Business Doing Index, Turkey ranked 65 among 183 countries [62].

investments. EU institutions have cooperated with NGOs and local authorities in Turkey, and have provided funds for projects including environment and renewable energy. This helped NGOs to learn from experiences of European countries, and to follow similar approaches regarding renewable energy policies. Moreover, EU's emphasis for stronger role of local authorities has helped to increase participation in decision-making processes with the recent changes in regulations, and this will possibly decrease the problems related with local opposition in Turkey. In addition, with the adoption of EU's Water Framework Directive[4] which aims to protect natural life and to protect water resources, EU has intensified its focus on the effective management of its water resources [70]. As a result, as a candidate country, Turkey has to reconsider its strong emphasis for small hydropower plants which creates significant opposition from local residents due to deterioration of natural life and adverse impact on communities [71]. One more point that EU can contribute is the management of Turkey's transboundary rivers notably the Euphrates and the Tigris. These rivers have a significant water potential, and they both rise in the north-eastern Anatolia and flow down through Turkey, Syria, and Iraq. Turkey's recent projects on these rivers notably Southern Anatolia Project, which envisages the installment of 19 hydropower plants with an installed capacity of 7476 MW, has encountered significant opposition from Syria [72]. Although there is no international agreement that dictates multinational control of transboundary waters, Turkey has agreed equitable and reasonable use of its transboundary waters with these countries [73]. Even if there has not been a conflict among Turkey, Syria and Iraq due to the quantity of water flow, water scarcity in the coming years may create problems in the region. As a global power, EU can have a role in the resolution of such problems without creating huge tensions among countries.

Secondly, EU's approach to form a renewable support mechanism compatible with internal energy market has also shaped Turkey's renewable energy policy. Internal energy market has been one of the major goals of EU, and non-member countries have also participated in internal market via Energy Community Treaty (ECT). Acknowledging the economic benefits, Turkey initiated liberalization process in parallel to EU Directives with an aim to full integration with internal energy market. In addition, Turkey is planning to join EU ETS in the coming years, and some improvements have been proposed in taxation system in line with EU directives which will encourage renewable energy investments in Turkey.

Finally, EU has been a strong supporter of technology development, and it has allocated significant amounts funds for technology development in member states and candidate countries. In this respect, Turkey has acquired more than 30 million EUR during 2007–2009 under EU 7th Framework Programme. Moreover, Turkish companies, NGOs and local authorities have benefitted from a number of EU funds. Additionally, Turkey's legal framework regarding intellectual and property rights has been improved in line with EU's *acquis*, and this has also improved Turkey's technology and innovation profile. As a result, these developments can help Turkey to initiate RES technology creation and foster localization in Turkey.

## 6. Concluding remarks

An assessment of Turkey's renewable energy policy showed that Turkey's renewable energy policy has many flaws, and these flaws hinder the appropriate use of renewable energy sources in electricity generation despite recent progress in supporting renewable energy technologies. The major flaw is the lack of political commitment. Turkey has recently provided support for small RES investments, and a comprehensive renewable energy strategy that covers environmental, social and economic aspects of RES technologies has not been established. Secondly, incentives are low compared to EU countries and investors still encounter administrative barriers. Moreover, local opposition slows down many projects. Finally, Turkey still imports most RES technologies and localization is low, and this hinders domestic job creation and technology development. In this context, EU can contribute significantly to improve Turkey's renewable energy policy and to overcome these problems. Firstly, increasing cooperation with EU will provide the impetus in political commitment. EU has been the main factor in shaping Turkey's renewable energy policy so far. Even though Turkey ratified Kyoto Protocol, EU seems to be more effective in driving renewable energy policy along with domestic factors. Therefore, the authors believe that EU's emphasis for renewable energy technologies will also significantly shape Turkey's policy. In addition, the interaction of Turkish NGOs with European counterparts will help to increase environmental consciousness in Turkey. Secondly, EU's efforts to integrate internal energy market and renewable energy support schemes had an impact on Turkey's energy markets, and Turkey is taking similar measures to integrate itself into internal energy market. Finally, EU's support for technology development has positive effects on Turkey, and EU's technology policies and funds for technology creation have helped to improve Turkey's technology and innovation profile. Therefore, the authors believe that EU has contributed and will continue to contribute to Turkey in utilizing its renewable energy potential, and Turkey should increase cooperation with EU in renewable energy policies no matter what the result of accession negotiations may be.

[4] Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.

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